The AorTech VULCAN: Intraoperative Aortic Clamp for Use During Open Abdominal Aortic Aneurysm Procedures

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ABSTRACT
Abdominal aortic aneurysms (AAA) are the 10th leading cause of death in men over 50 and are caused by abdominal aortic wall weakness, high blood pressure, and genetics. If the aneurysm reaches a diameter of 5.5 cm or greater, surgical intervention is recommended. The two surgical approaches currently utilized are the trans-abdominal approach, which replaces the aneurysm with a graft, and the open approach, in which the surgeon approaches the aneurysm in the abdomen and replaces the weakened part of the aorta with a graft. During this highly invasive procedure, the blood flow through the aorta must be occluded by use of an aortic clamp to allow the physician to remove the clot and insert a graft. Current clamp technology poses many opportunities for improvement in order to create a safer procedure. These clamps have standard ratcheting mechanisms that make smooth release from the aorta difficult, can cause trauma to tissue, and can slip down the aorta during surgery. After interviewing several vascular surgeons to determine unmet needs, a design was created to address these needs of providing a smooth and controllable ratcheting mechanism, occluding arteries without damaging tissue, and ensuring a constant clamping force for the duration of surgery. After a plastic prototype was created, additional feedback was obtained from surgeons that resulted in further modifications. The final clamp design, the AorTech VULCAN, incorporates a novel ratcheting mechanism, can deliver 1100, and soft jaw inserts to provide abraneous cushioning. Testing was performed which validated full occlusion for the duration of surgery, determined the amount of force required at each ratcheting position, and compared visual tissue damage and holding force for several jaw insert surface characteristics. While further improvements can still be made, the AorTech VULCAN has shown success in addressing customer needs and shows promise in entering the surgical instrument market.

INTRODUCTION
AorTech’s Mission
AorTech will be a leader in reliable and safe surgical instruments. AorTech strives to develop a vascular clamp to optimize ease of use and application as well as safety in highly invasive vascular procedures. Our company will collaborate with vascular surgeons with the intent of reducing associated surgical risks to the patient and will ensure a return on investment for our shareholders.

Background:
Abdominal aortic aneurysms (AAA) are the 10th leading cause of death in men over 50.

Causes
- Atherosclerosis
- Smoking, high blood pressure, diabetes, and genetics
- Surgery recommended for aneurysm >5.5 cm

Aortic clamps utilized to occlude blood flow through the aorta during open AAA procedures.

Problems with current vascular clamps:
- Can cause trauma to tissue
- Lack of security
- Manual control while removing clamp from surgical site
- Risk of sliding down aorta during procedure due to highly pressurized blood flow

Difficult to use ratcheting mechanism

Customer Needs and Specifications:
- Clamp must be able to deliver arteries without damaging tissue
- Clamp must be easy to close and open
- Clamp must be able to provide a consistent clamping force for the entire duration of the procedure
- Clamp must be able to satisfy arterial blood pressure
- Clamp must be able to withstand aortic blood pressure

THE AORTECH VULCAN

The AorTech VULCAN: Clamping Jaw Insert Renders

THE TESTING

TESTING

TESTING

CAUTION

CONCLUSION

AorTech has developed a vascular clamp to occlude blood flow during an open abdominal aortic aneurysm surgery. It was shown through testing that the AorTech VULCAN is able to occlude blood flow through a duration equivalent to a standard AAA procedure. Testing was also performed to quantify the amount of force the clamp was able to apply to the blood flow. It was found that the distribution of force along the jaw length is uneven with a smaller force being generated against the jaw tip. With the current methods of quantifying clamping force, future developments will include forcing testing distribution of different shaped jaws.

It was important for the VULCAN to cause minimal damage to tissue during occlusion. Results from testing have shown that smooth jaw surface characteristics visually yield the least amount of damage to a postoperative aorta. It was also shown that the smooth jaw surface characteristics had the strongest holding force making it least likely to slip along an aorta.

AorTech will be a leader in reliable and safe surgical instruments. AorTech has collaborated with vascular surgeons with the intent of reducing associated surgical risks to the patient. AorTech has developed a vascular clamp to optimize ease of use and application as well as safety in highly invasive vascular procedures.

Recommendations for the Future
- Integrate a biomechanical mechanism to remove clamp from the visual field of the surgeon
- Change jaw shape to create a more uniform distribution of force

REFERENCES

Dr. Steven Haffeman
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